## Section 3 - West Colorado River Basin
# Introduction

# Section 3
## West Colorado River Basin - Utah State Water Plan

# Introduction

### 3.1 Background

The people of Utah have always planned for the protection and use of water resources through cooperative efforts. State directed water planning was formalized by specific legislation in 1963 and re-emphasized in the 1980s. The *West Colorado River Basin Plan* is part of the *State Water Plan (1990)*, which describes a process for planning, conserving and developing the state's water resources and is another step in that process.

**The *West Colorado River Basin Plan* covers all aspects of Utah's water Resources and has the flexibility to be changed as future conditions require.**

### 3.2 Planning Guidelines [17]

The *State Water Plan* describes basic premises and lays the foundation for all state water planning. This ensures continuity and consistency of individual basin plans with the statewide plan and with each other.

#### 3.2.1 Principles

Many values, uses and interests are involved in preparing a basin plan. Certain guiding principles should also be considered. These are listed below.

- All waters, whether surface or subsurface, are held in trust by the state as public property and their use is subject to rights administered by the state engineer.
- Water is essential to life. It is our responsibility to leave good quality water to meet the needs of the generations to follow.
- The diverse present and future interests of Utah's residents should be protected.
- Water uses for which beneficiaries are difficult to identify, such as recreation and aesthetics, should be included in program evaluation.
- Public input is vital to water resources planning.
- All residents of the state are encouraged to exercise water conservation and implement wise use practices.

Confluence of the Colorado and Green rivers

- Water rights owners are entitled to transfer their rights under free market conditions and in accordance with state water right laws.
- Water resources projects should be technically, economically and environmentally sound.
- Water planning and management activities of local, state and federal agencies should be coordinated.
- Local governments, with state assistance as appropriate, are responsible for protecting against emergency events such as floods and droughts.
- Designated water uses and quality should be improved or maintained unless there is evidence the loss in quantity or quality is outweighed by other benefits.
- Educating Utahns about water is essential. Effective planning and management requires a broad-based citizen understanding of water's physical characteristics, potential uses and scarcity values.

### 3.2.2 Purpose

The main purpose of this basin plan is to provide basic water data, identify issues, and describe future alternatives and possible development to provide for the water needs of future generations. Irreversible commitments could be very costly and prevent the fulfillment of future needs. Coordinated planning between state and federal agencies and local entities can be the vehicle to involve all concerned parties.

### 3.2.3 Organization

State water planning is the responsibility of the Division of Water Resources (DWRe) under the auspices of the Board of Water Resources. Several other state agencies with major water-related missions are involved in the water planning process.

With this in mind, a state water plan coordinating committee representing 12 state agencies assisted in the preparation of the *West Colorado River Basin Plan*. A steering committee also exists consisting of the chair and vice chair of the Board of Water Resources, executive director of the Department of Natural Resources, and director and assistant director of the Division of Water Resources. This committee provides policy guidance, resolves issues, and reviews the plan prior to final acceptance by the Board of Water Resources.

In addition, 20 federal and state agencies participate as cooperating entities. These agencies have particular expertise in various fields to assist with plan development. The local Basin Planning Advisory Group for the West Colorado River Basin also provides input by way of advice, review and decision-making. Most of the members of this group reside within or are directly involved in basin affairs. They represent various local interests and provide geographical representation within the basin.

### 3.2.4 Process

During the review and approval process, four drafts of the *West Colorado River Basin Plan* were prepared. These were: (1) In-House Review Draft, (2) Committee Review Draft, (3) Advisory Review Draft, and (4) Public Review Draft. Revised drafts occurred where warranted. After this process, the final basin plan is distributed to the public for its information and use. Once the final plan is distributed, the DWRe may periodically update the basin plan as conditions change. Local entities may also petition the DWRe to update the plan if they feel that situations within the basin have changed considerably. Much of the basin water data in the plan will be continually updated by the DWRe through ongoing planning efforts.

## 3.3 Basin Description

The West Colorado River Basin, covering nearly 15,000 square miles (9,783,815 acres) in south central Utah, is shown on Figure 3-1. The basin is bounded by the following features, described in a clockwise path, beginning at Soldier Summit (at the top of Spanish Fork Canyon) and following along the Book Cliffs, then south along the Green River to the confluence with the Colorado River, then southwesterly along the Colorado River

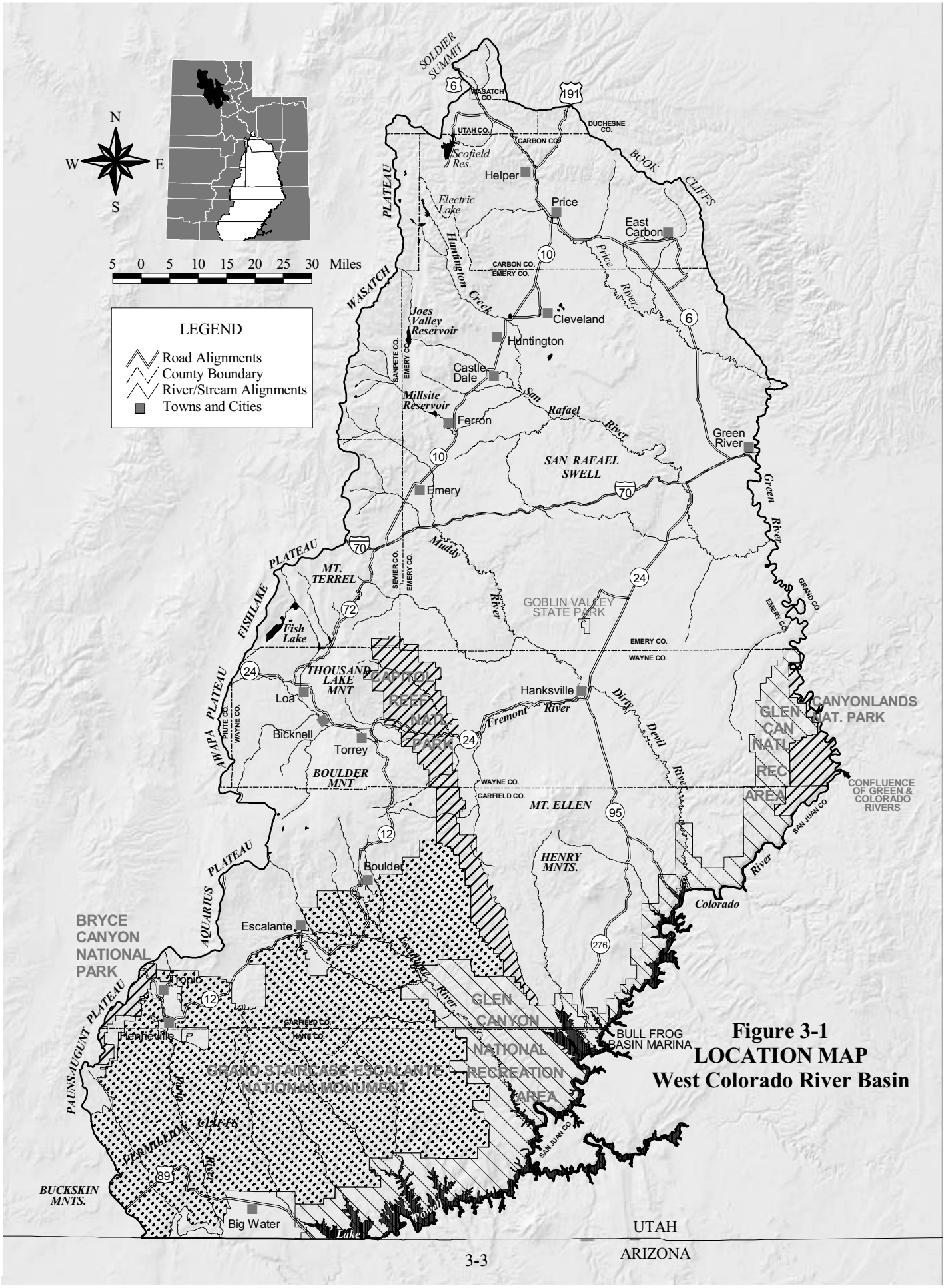


**Figure 3-1**
**LOCATION MAP**
**West Colorado River Basin**

and the eastern shoreline of Lake Powell (to include the entire surface of the lake). It then goes west along the Utah-Arizona state line to Buckskin Mountain, then bisecting the Vermillion Cliffs northwesterly to the rim of Bryce Canyon (Paunsaugunt Plateau), along the Aquarius Plateau, the Awapa Plateau, the Fish Lake Plateau, and along the Wasatch Plateau back to Soldier Summit. The irrigated area around Green River and the part of town on the eastern side of the Green River (located in Grand County) are included within the boundaries of this basin.

The basin covers all or part of 13 counties: Carbon, Duchesne, Emery, Garfield, Grand, Kane, Piute, San Juan, Sanpete, Sevier, Utah, Wasatch and Wayne. Major communities of the basin and their populations are shown in Table 3-1. In all, the West Colorado River Basin contains 25 incorporated towns and cities.

The West Colorado River Basin consists of five separate hydrologic river drainages, all flowing into the Green or Colorado river systems. These include the Price River, San Rafael River, Dirty Devil River (the combined Muddy and Fremont rivers), Escalante River and Paria River (Utah portion). The entire Utah portion of Lake Powell is located within the West Colorado River Basin.

Notable physiographic features are the San Rafael Swell, Henry Mountains, Boulder Mountain, Kaiparowits Plateau, Fishlake Plateau and the Wasatch Plateau. The area includes Capitol Reef National Park, and portions of Bryce Canyon National Park, Canyonlands National Park (the Maze and Horseshoe Canyon districts), Glen Canyon National Recreation Area (Lake Powell), and the new Grand Staircase-Escalante National Monument. Eight state parks in the basin are Scofield, Huntington, Millsite, Green River, Anasazi Indian Village, Escalante Petrified Forest, Goblin Valley and Kodachrome Basin. The three national forests located in the basin are Dixie, Fishlake and Manti-La Sal.

### 3.3.1 History and Settlement [7, 45, 46]

The history and settlement of the West Colorado River Basin is varied. In prehistoric times, dinosaurs roamed the area in a much different environment and climate than today. The Anasazi, Sevier and Fremont tribes were among the more recent early human inhabitants about 1,500 to 600 years ago. In the mid to late 1800s, most areas were settled by expansion of The Church of Jesus Christ of Latter-day Saints (Mormons). Coal mining in the northern part of the basin added more people in the early part of the 20th century.

**Geologic History** - Approximately 230 million years ago the basin was covered with blowing sand dunes. The San Rafael Swell and the Grand Staircase-Escalante National Monument have evidence of these ancient dunes. Dinosaurs roamed the area and tracks are found throughout the basin,

Cleveland-Lloyd Quarry Museum

covering the Triassic (Chinle Formation) and the Lower Jurassic (Navajo and Kayenta Formations) Periods of the Mesozoic Era. Following the desert-like conditions of these periods, the Middle Jurassic Period (about 200 million years ago) is marked by a series of invasions from the north by an interior seaway. The Entrada Sandstone formation of this

**Table 3-1**
**West Colorado River Basin Communities**

| Community | County | 1998 Population |
|---|---|---|
| **Incorporated** | | |
| East Carbon | Carbon | 1,517 |
| Helper | Carbon | 2,423 |
| Price | Carbon | 9,239 |
| Scofield | Carbon | 56 |
| Sunnyside | Carbon | 328 |
| Wellington | Carbon | 1,806 |
| Castle Dale | Emery | 1,800 |
| Cleveland | Emery | 556 |
| Elmo | Emery | 281 |
| Emery | Emery | 260 |
| Ferron | Emery | 1,739 |
| Green River | Emery | 704 |
| Huntington | Emery | 1,921 |
| Orangeville | Emery | 1,674 |
| Boulder | Garfield | 225 |
| Cannonville | Garfield | 147 |
| Escalante | Garfield | 994 |
| Henrieville | Garfield | 165 |
| Tropic | Garfield | 414 |
| Big Water | Kane | 420 |
| Bicknell | Wayne | 340 |
| Hanksville | Wayne | 160 |
| Loa | Wayne | 499 |
| Lyman | Wayne | 223 |
| Torrey | Wayne | 145 |
| **Unincorporated** | | |
| Carbonville | Carbon | 350 |
| Clear Creek | Carbon | 50 |
| Spring Glen | Carbon | 800 |
| Clawson | Emery | 150 |
| Caineville | Wayne | 50 |
| Fremont | Wayne | 250 |
| Teasdale | Wayne | 175 |

period near Goblin Valley State Park and other areas shows evidence of this with fossilized marine invertebrates and numerous dinosaur tracks. The Upper Jurassic Period (about 150 million years ago) is represented by fluvial sediments which have yielded many fossilized dinosaur bones located in Emery County at the Cleveland-Lloyd Quarry.

The Lower Cretaceous Period (about 125 million years ago) contained many new species of dinosaurs, including the now famous Utah raptor. Dinosaur eggshell material from this period has been found in the Cedar Mountain Formation of the San Rafael Swell. Episodes of mountain building that formed the Rocky Mountains began at the end of the Upper Cretaceous Period (about 80 million years ago). As the seas were retreating for the last time, extensive swamps formed along the edges. The Blackhawk Formation of this period is found in the coal mines of Carbon and Emery counties and contains numerous dinosaur tracks and fossilized plant life.

At the beginning of the Cenozoic Era (about 60 million years ago), the San Rafael Swell began to fold upward. Continued warping of the Colorado Plateau produced giant lakes over most of the basin about 40 million years ago. After this, the plateau began a gradual uplift which continues today. From this, the major river basins formed, producing the beautiful canyons and features that millions of tourists from around the world come to see. The Cleveland-Lloyd Museum (Emery County), the Museum of the San Rafael (Castle Dale), and the College of Eastern Utah Prehistoric Museum (Price) provide interesting information on the geologic history of this area.

**Pre-History** - The initial human occupants of the West Colorado River Basin were apparently nomadic hunters of the Paleo-Indian period (12,000-8,500 years ago) who sought after the mammoths, camels, and bison of the late Pleistocene. Five kill/butchering sites have been found in the basin. About 8,500 years ago, groups characterized by the use of the atlatl (dart-throwing weapon), milling stones and a variety of textiles, appeared in Utah. Five sites of this Archaic-Indian culture (8,500-2,500 years ago) have been identified within the basin.

The Agriculturists period (1,500-600 years ago) contained the Anasazi, Fremont and Sevier cultures. The northern and central portion of the West Colorado River Basin contains numerous sites of the Fremont culture, while the southern portion contains Anasazi sites. The Sevier culture is also in evidence on the extreme western side of the basin. All of these cultures are marked by peoples who subsisted, at least in part, on domesticated crops and shared a number of technological and adaptive characteristics such as pottery, the bow and arrow, and settled villages. There is some evidence that these cultures may have irrigated their crops. For unknown reasons, the Sevier and Fremont cultures disappeared from Utah about A.D. 1300. At the height of these cultures, it is estimated that the population found within the state's boundaries was as high as 500,000. The Anasazi Indian Village State Park (Boulder) and the Fremont Indian State Park (Sevier River Basin) provide information about these cultures.

The arrival of modern Indian groups ushered in the last and present period. Competition with these groups may have contributed to the disappearance of the Sevier and Fremont and the withdrawal of the Anasazi cultures. About 1,000 years ago the Southern Paiutes arrived in the extreme southern portion of the West Colorado River Basin. Among the Paiute Tribe, the Shivwits Band occupied the greatest area while the Fish Lake Paiutes lived in and around Fish Lake. The Ute Tribe occupied the remainder of the basin to the north. Economics determined that these people lived in small bands of fewer than 200 people. No Indian reservations are located within the West Colorado River Basin.

**History** - The first Europeans to enter the state and the West Colorado River Basin were in the Dominguez-Escalante expedition. On their return to Sante Fe in 1776, after exploring western Colorado, the Uinta Basin, Utah Lake area, western Utah and southwestern Utah, the party came upon the Colorado River at the mouth of the Paria River. They determined crossing there was not feasible (a

century later it would become Lee Ferry Crossing), so they went up river to a point three miles north of the Arizona-Utah border ("Crossing of the Fathers").

During the early 1800s, fur trappers explored mainly northern Utah. There are records, however, that Etienne Provost (1824-1825) and Jedediah Smith (1826-1829) went through parts of the West Colorado River Basin. Between 1829 and 1848, a trade route was opened up between Sante Fe and Los Angeles. This trail, known as the Spanish Trail, was used chiefly by New Mexico traders who found a ready market for woolen goods in California. The 1,120 mile trail entered the West Colorado River Basin from the east along present day I-70, crossed the Green River at Green River, continued through the San Rafael Swell, then down Salina Canyon and into the Sevier River Basin. With the gold rush in California and the subsequent growth in population there, a move to promote a transcontinental railroad arose.

John W. Gunnison received a government commission in 1853 to survey a proposed route for the railroad. He came through the West Colorado River Basin near Green River south along the Book Cliffs and located a passage through the Wasatch Mountains into the Great Basin (Soldier Summit). He was later killed by Indians in the Sevier River Basin. But he was credited with establishing a military road and determining that his southern railroad route was far inferior to the northern route across Wyoming.

John Wesley Powell led a 10-man party down the Green and Colorado rivers in 1869. Compared to all previous western government expeditions, Powell's were highly scientific surveys. The results of his surveys are contained in his famous *Report on the Lands of the Arid Regions of the United States*. Included in this report was his recommendation that minimum homesteads in non-irrigable pasture lands of the west should be 2,500 acres. Although this concept was too revolutionary to find acceptance by Congress at the time, subsequent legislation recognized the need for larger tracts of land in the arid west. The John Wesley Powell Museum (Green River) provides information on these government expeditions.

**Settlement** - The majority of the settlement of the West Colorado River Basin was a result of Mormon exploration and expansion. Upon entering the Salt Lake Valley on July 24, 1847, Brigham Young stated that his intentions were to "explore every hole and corner from the Bay of San Francisco". At his death in 1877, Young had fulfilled that pledge and had been successful in colonizing large portions of the Intermountain West.

Carbon County settlements were established by the Mormons along the Price River in the late 1870s, including Price, Spring Glen and Wellington. Farming and ranching became early economic activities, giving Carbon County a tradition of cowboys and outlaws with the likes of Butch Cassidy and "Gunplay" Maxwell roaming the area. The Nine Mile Canyon freight road from Price to the Uinta Basin became an important transportation link. During the early 1880s, the Denver and Rio Grande Western Railroad (D&RGW), seeking a route from Denver to Salt Lake City, discovered and opened up the vast coal lands of the county.

Coal mining became the major catalyst for development. Coal companies often built and ran towns and imported many southern and eastern European and Japanese laborers to work in the coal mines and on railroad gangs. Mine explosions and major strikes from 1900-1930 brought tragedy, violence, and eventual unionization to the mines. Coal mining continues to play a vital role in Carbon County's economic development, with ups and downs in the industry creating periods of boom and bust. The College of Eastern Utah (Price) was established in 1937 and promises to become a more important facet of the county's economic and social development.

Emery County's settlement, similar to Carbon County, started in 1875 when livestock raisers from Sanpete County brought cattle and sheep into Castle Valley to graze. With a shortage of sufficient land and water in Sanpete County and a strong desire of Mormon leaders to acquire unoccupied land in the region before non-Mormons did, families began moving into Castle Valley in the fall of 1877. They

took up homesteads in what would become Huntington, Ferron, Castle Dale and Orangeville. The completion of the D&RGW through the county in 1883 and the development of coal mines in Carbon County ensured the county's economic stability. The D&RGW also re-established the town of Green River, although it had already been a mail station and an important part of the Old Spanish Trail.

The southeastern Utah uranium boom in the 1950s provided a temporary economic stimulus. The establishment of the Utah Launch Complex of the White Sands Missile Base in 1964 brought a temporary boom to Green River. However, the closing of the complex in the 1970s led to another economic downturn. During the late 1970s, Emery County's population grew significantly because of the construction, by Utah Power and Light Company, of large power plants in Castle Dale and Huntington and the opening of large coal mines to fuel them. Today the power plants, along with their coal mines, farming and tourism, provide a solid basis for Emery County's economy.

Because of Wayne County's remote location, most of its towns were settled after 1880. The first settlement was in Rabbit Valley between Fremont and Loa. The town of Bicknell was originally called Thurber, but its name was changed when Thomas Bicknell, a prominent educator from Rhode Island, offered a library to any town that would take his name. Raising livestock was the main reason for settlement, although Fruita (now part of Capitol Reef National Park) was settled for its fruit-growing potential. Getting cattle to market was difficult. Until good roads were built in the 1930s, stock was driven some 100 miles north to railheads at Nephi, Green River, and later to a D&RGW branch line in Sevier County. The creation of national forests in the early 1900s reduced the number of cattle that could be grazed (See Section 3.4). In the central portion of Wayne County, Capitol Reef National Monument, established in 1937 (later Capitol Reef National Park), and Lake Powell recreationalists stopping for supplies now fuel a tourism-related economy. In the Upper Fremont Valley (western portion of Wayne County), agriculture still dominates the economy.

Eastern Garfield County was settled by people from Beaver and Parowan (Cedar/Beaver River Basin) via Panguitch (Sevier River Basin). Escalante was settled in 1875, and later settlements were made in Cannonville (1876), Henrieville (1878), Boulder (1889) and Tropic (1892). Boulder was considered the most isolated town in Utah until the mid-1930s when Civilian Conservation Corps (CCC) workers constructed a road from Boulder to Escalante over "Hell's Backbone". Vast rangelands and some of the state's largest forest reserves made cattle-ranching and lumbering Garfield County's most important industries.

The creation of Bryce Canyon National Park in 1928 increased the importance of tourism in the area. The local economy, with the additions of Capitol Reef National Park, Glen Canyon National Recreation Area and the new Grand Staircase-Escalante National Monument, is being greatly influenced by recreation and tourism. However, with the reopening of the lumber mill in Escalante and the continued dependence on agriculture, lumbering and agriculture will continue to be factors affecting the local economy.

The eastern portion of Kane County was settled with creation of Lake Powell. The city of Glen Canyon (later renamed Big Water) was created in 1956 as a construction camp. Big Water and nearby Church Wells are small communities with many residents commuting to work to Page, Arizona. The remainder of the county located in the West Colorado River Basin is rugged land now mostly within the boundaries of the Grand Staircase-Escalante National Monument. Therefore, similarly to Garfield County, recreation and tourism will probably become important aspects of the local economy. Existing oil, coal and gas leases located throughout the county, however, could provide a boost to the local economy. Also, the recent 50,000 acre state/federal land exchange along Highway 89 west of Big Water could provide areas for retirement communities or tourist facilities.

### 3.3.2 Climate [3]

Precipitation in the area is influenced by two major storm patterns: one, frontal systems from the Pacific Northwest during winter and spring; the other, late summer and early fall thunderstorms from the south and southwest. The Southern Utah Low, a high altitude low pressure system often covering parts of several states, causes wide-spread precipitation between the winter frontal systems and summer thunderstorms.

The basin has 27 climatological stations where daily temperatures and precipitation are measured and 10 snow course sites where winter snowpack is measured. Nine telemetry systems have been installed within the basin to make data available on a continuous basis (SNOTEL sites). The 1961-1990 base period is used in this report. The climatological and SNOTEL stations are shown on Figure 3-2. All of these stations are extremely important to local, state and federal water managers.

Annual water surface pan evaporation varies from about 45 inches at Loa to 58 inches at Hite Marina on Lake Powell. Possible sunshine varies from 85 percent during the summer to 45 percent during the winter. Prevailing winds are generally from the southwest at four to six miles per hour. Maximum wind movement generally occurs during May.

**Temperature** - Temperatures fluctuate every year from a maximum of over 100° F to a minimum below zero with daily variations as much as 40° F. The mean annual temperature in the agricultural valleys varies from 44° F in Loa (Wayne County), 46° F in Emery (Emery County), 49° F in Price (Carbon County) and Escalante (Garfield County), and 53° F in Green River (Emery County). The average agricultural frost-free periods range from 80 days in Loa to 165 days in Green River. Temperature data are given in Table 3-2.

**Precipitation** - The precipitation ranges from over 30 inches in the Wasatch and Fish Lake plateaus to less than eight inches in the desert areas of the central and southern parts of the basin. Climate in the agricultural areas is arid to semi-arid with an average precipitation of about 10 inches. Precipitation can be highly variable, some wet years receiving three times that in the drier years. The annual precipitation for the basin is shown on Figure 3-3. The annual precipitation for all basin stations is shown in Table 3-3.

**Evapotranspiration** - Evapotranspiration varies among crops. Instead of calculating evapotranspiration for each crop, it is customary to calculate values for a reference crop to obtain a *reference evapotranspiration* value. The reference value is multiplied by a crop coefficient for another crop to obtain an evapotranspiration value for that crop. Care must be exercised in applying crop coefficients because different researchers use different reference crops. The reference evapotranspiration values for the basin stations given in Table 3-3 use perennial rye grass for the reference crop.

Snow course records show accumulated water content collected during the winter months. The National Resources Conservation Service operates mountain SNOTEL sites that automatically record snowpack data. Both types of stations can be accessed to determine monthly, daily or even single storm accumulations. The April 1 forecast is the water supply indicator for the coming season. This is based on the snow course soil moisture levels, snow pack water content and other factors. Snow water equivalent and total precipitation for the basin's snow course and SNOTEL sites are shown in Table 3-4.

### 3.3.3 Physiography and Geology [22, 35, 51]

The West Colorado River Basin as described here falls entirely within the Colorado Plateau Physiographic Province. The basin contains 9,783,810 acres (15,000 square miles) and is about 205 miles from north to south and 107 miles from east to west. It includes the through-flowing Green and Colorado rivers and the following major tributaries: 1) Price River system, 2) San Rafael River system, 3) Dirty Devil River system (the combined Muddy and Fremont rivers), 4) Escalante River system, and 5) Paria River system.

The Colorado Plateau Physiographic Province is characterized by high relief between the many high tablelands or plateaus and the intervening

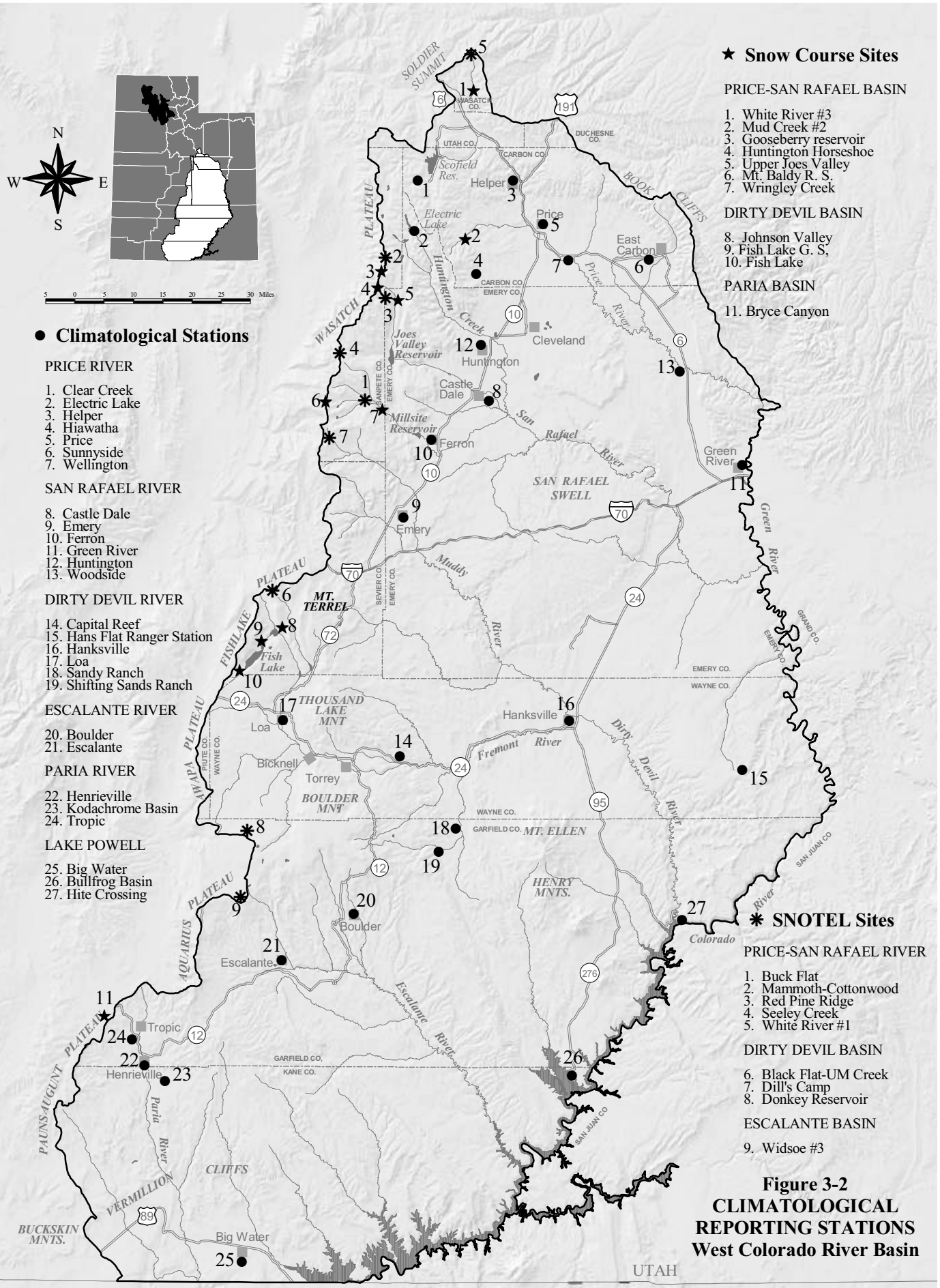


**Figure 3-2**
**CLIMATOLOGICAL REPORTING STATIONS**
**West Colorado River Basin**

**Table 3-2**
**Normal Temperatures and Frost-Free Days**

| Station | January Max. (°F) | January Min. (°F) | July Max. (°F) | July Min. (°F) | Mean Annual (°F) | Frost-Free Days |
|---|---|---|---|---|---|---|
| **Price River System** | | | | | | |
| Clear Creek | 31.3 | 6.5 | 76.7 | 41.7 | 38.0 | 52 |
| Green River Aviation | 37.1 | 8.7 | 96.7 | 60.4 | 51.9 | 163 |
| Hiawatha | 32.8 | 13.2 | 81.6 | 54.9 | 44.5 | 128 |
| Price Game Farm | 36.8 | 10.9 | 90.9 | 56.5 | 49.1 | 146 |
| Scofield | 31.6 | 0.0 | 76.7 | 40.6 | 36.7 | 42 |
| Scofield Dam | 27.6 | -1.6 | 77.5 | 44.5 | 36.9 | 74 |
| Scofield-Skyland Mine | 32.3 | 9.0 | 73.8 | 45.3 | 38.4 | 73 |
| Sunnyside | 34.1 | 13.8 | 84.3 | 55.3 | 45.7 | 126 |
| Sunnyside City Center | 32.5 | 14.3 | 85.7 | 57.0 | 48.3 | 147 |
| **San Rafael River System** | | | | | | |
| Castle Dale | 35.8 | 7.6 | 89.6 | 53.8 | 47.4 | 124 |
| Electric Lake UP&L | 26.7 | -0.4 | 71.8 | 41.4 | 34.2 | 67 |
| Emery | 36.4 | 11.2 | 84.2 | 53.1 | 46.1 | 126 |
| Ferron | 35.5 | 10.5 | 87.1 | 57.7 | 47.8 | 136 |
| **Dirty Devil River System** | | | | | | |
| Capitol Reef National Park/Fruita | 39.8 | 18.1 | 92.2 | 63.1 | 53.7 | 179 |
| Hanksville | 40.3 | 10.2 | 98.8 | 58.1 | 53.1 | 154 |
| Hans Flat Ranger Station | 36.3 | 18.6 | 85.7 | 61.1 | 50.4 | 158 |
| Loa | 39.4 | 7.4 | 82.8 | 47.2 | 43.6 | 83 |
| Sandy Ranch | 39.2 | 12.2 | 91.6 | 57.9 | 50.3 | 137 |
| Shifting Sands Ranch | 34.9 | 12.3 | 90.1 | 61.7 | 52.0 | 188 |
| **Escalante River System** | | | | | | |
| Boulder | 38.7 | 15.8 | 84.6 | 57.9 | 48.5 | 137 |
| Escalante | 41.0 | 14.1 | 89.9 | 54.7 | 49.7 | 138 |
| Henrieville | 42.3 | 13.4 | 88.1 | 52.7 | 48.3 | 118 |
| Kodachrome Basin | 44.2 | 14.4 | 89.8 | 51.7 | 49.3 | 119 |
| Tropic | 40.9 | 14.7 | 84.9 | 51.6 | 46.9 | 119 |
| **Colorado River System** | | | | | | |
| Big Water | 44.3 | 20.5 | 98.7 | 64.9 | 56.7 | 189 |
| Bullfrog Basin | 44.5 | 24.5 | 99.4 | 70.3 | 59.4 | 219 |
| Hite | 47.8 | 26.4 | 100.0 | 70.9 | 61.0 | 234 |

Note: All temperatures are 1961-90 normal values. Frost-free days are from average last spring to first fall freezes (32°F).
Source: Utah Climate.

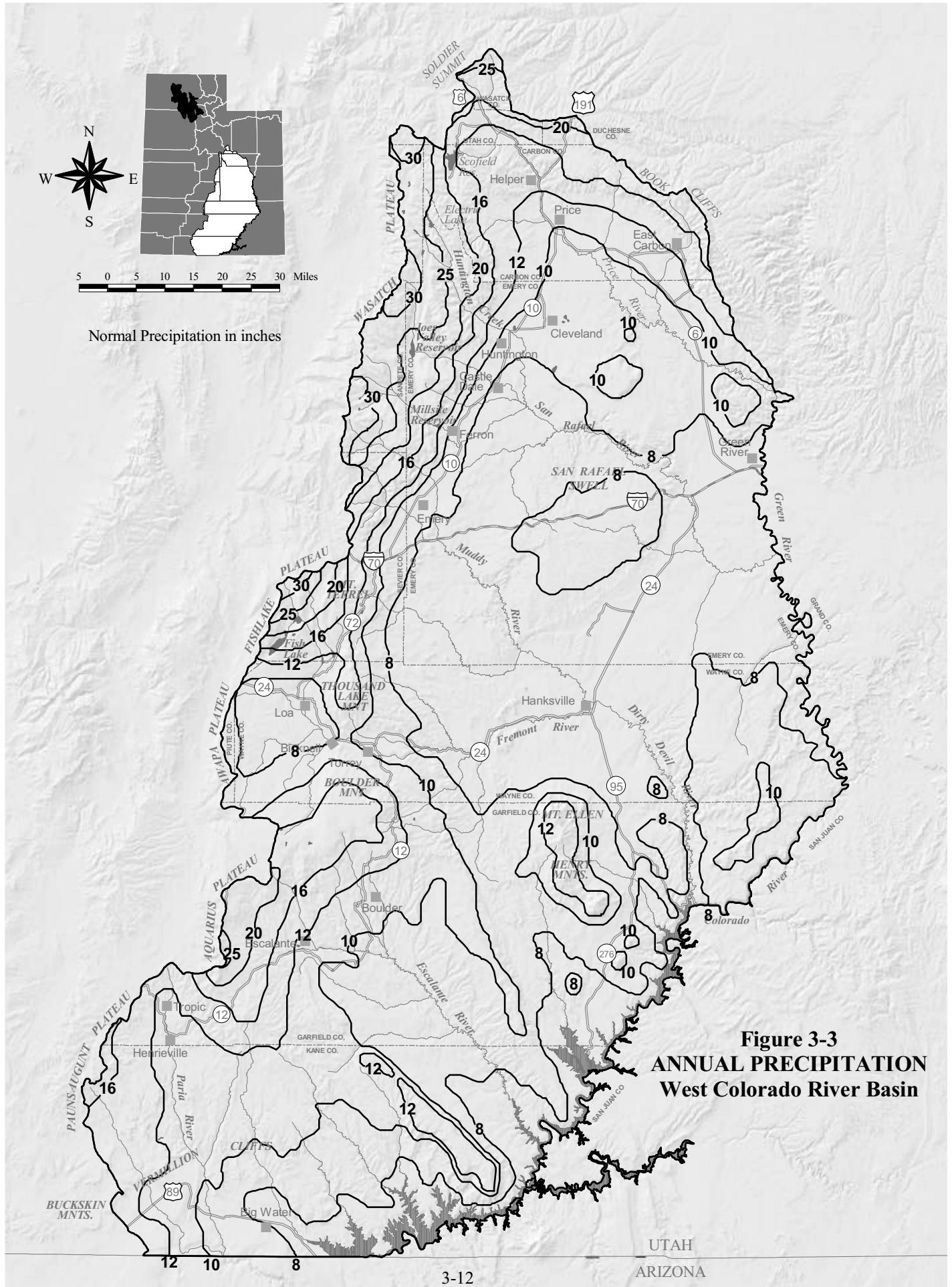


**Figure 3-3**
**ANNUAL PRECIPITATION**
**West Colorado River Basin**

**Table 3-3**
**Normal Precipitation and Evapotranspiration**

| Station | Annual Precipitation (inches) | Reference Evapotranspiration (inches) |
|---|---|---|
| **Price River System** | | |
| Clear Creek | 23.05 | 36.98 |
| Green River Aviation | 6.51 | 55.86 |
| Hiawatha | 14.60 | 38.63 |
| Price Game Farm | 9.75 | 48.78 |
| Scofield | 17.22 | 37.64 |
| Scofield Dam | 14.07 | 36.72 |
| Scofield-Skyland Mine | 23.33 | 34.48 |
| Sunnyside | 13.87 | 41.23 |
| Sunnyside City Center | 11.57 | 42.85 |
| **San Rafael River System** | | |
| Castle Dale | 7.52 | 48.07 |
| Electric Lake UP&L | 24.91 | 31.77 |
| Emery | 7.56 | 44.27 |
| Ferron | 8.47 | 45.14 |
| **Dirty Devil River System** | | |
| Capitol Reef N.P./Fruita | 7.48 | 49.74 |
| Hanksville | 5.72 | 56.17 |
| Hans Flat Ranger Station | 10.15 | 41.98 |
| Loa | 7.85 | 44.93 |
| Sandy Ranch | 7.56 | 51.00 |
| Shifting Sands Ranch | 6.89 | 48.06 |
| **Escalante River System** | | |
| Boulder | 10.73 | 43.60 |
| Escalante | 10.04 | 48.89 |
| Henrieville | 10.38 | 49.62 |
| Kodachrome Basin | 11.92 | 49.30 |
| Tropic | 12.33 | 46.96 |
| **Colorado River System** | | |
| Big Water | 6.92 | 57.15 |
| Bullfrog Basin | 5.93 | 55.24 |
| Hite | 5.68 | 57.91 |

Note: All data for 1961-90 time period.
Source: Utah Climate.

**Table 3-4**
**Snow/Precipitation Data**

| Station | Elevation | Average April 1 Snow Water Equivalent (inches) | Average Total Precipitation |
|---|---|---|---|
| SNOW COURSE SITES | | | |
| **Price-San Rafael Basin** | | | |
| Gooseberry Reservoir | 8,700 | 11.5 | N/A |
| Huntington Horseshoe | 9,800 | 24.3 | N/A |
| Mt. Baldy R. S. | 9,500 | 24.1 | N/A |
| Mud Creek #2 | 8,600 | 13.6 | N/A |
| Upper Joes Valley | 8,900 | 10.3 | N/A |
| White River #3 | 7,400 | 6.8 | N/A |
| Wringley Creek | 9,000 | 11.3 | N/A |
| **Dirty Devil Basin** | | | |
| Fish Lake | 8,700 | 8.0 | N/A |
| Johnson Valley | 8,850 | 7.1 | N/A |
| **Paria Basin** | | | |
| Bryce Canyon | 8,000 | 4.2 | N/A |
| SNOTEL SITES | | | |
| **Price-San Rafael Basin** | | | |
| Buck Flat | 9,800 | 18.1 | 18.4 |
| Mammoth-Cottonwood | 8,800 | 21.0 | 17.6 |
| Red Pine Ridge | 9,200 | 18.0 | 20.6 |
| Seeley Creek | 10,000 | 15.3 | 15.3 |
| White River #1 | 8,550 | 13.9 | 14.6 |
| **Dirty Devil Basin** | | | |
| Black Flat-U. M. Creek | 9,700 | 10.3 | 12.9 |
| Dill's Camp | 9,200 | 15.1 | 16.8 |
| Donkey Reservoir | 9,800 | 9.1 | 11.6 |
| **Escalante River Basin** | | | |
| Widstoe #3 | 9,500 | 14.0 | 13.9 |

Note: Averages based on April 1 snowpack from 1961-90.
Source: U. S. Natural Resources Conservation Service

stream cut valleys and deep, steep-sided canyons. Elevations over 11,000 feet are found in the Henry Mountains, Thousand Lake Mountain, Boulder Mountain and on the Fishlake Plateau. Mt. Ellen, located in the Henry Mountains, stands 11,522 feet; Mt. Terrel, on the Fish Lake Plateau, stands at 11,530 feet; Thousand Lake Mountain stands at 11,306 feet; and Boulder Mountain is just over 11,000 feet. Elevations begin at 3,700 feet above mean sea level in Lake Powell at the southern tip of the basin and increase throughout several valleys and into higher plateaus. Much of this difference in elevation is made up in great step-like features, consisting of a series of retreating cliffs or escarpments and structural benches that result from erosion of the flat to gently dipping sedimentary rocks which are of variable hardness and thus offer more or less resistance to erosion. The Grand Staircase in Garfield and Kane counties is a good example of this type of geologic feature (see Figure 3-4). The Green and Colorado rivers fall 500 feet from the Price River's confluence with the Green to Lake Powell, a distance of over 128 miles. The average fall is just less than four feet per mile.

Within this basin, each plateau, mountain and canyon has its own character, which influences soil forming processes and the surface and groundwater hydrology. Past erosion and deposition cycles have left pediment slopes and terraces. Erosion has produced the spectacular scenery of Bryce Canyon, Capitol Reef, Goblin Valley and Glen Canyon. Rocks from all eras of geologic time are found here with the greatest area being covered by sedimentary rocks of Mesozoic age (see Figure 3-5). Included in this group is the Navajo Sandstone which is an important source of groundwater. Igneous rock is found on many of the basin's mountain ranges. In many places they occur as Tertiary age extrusive

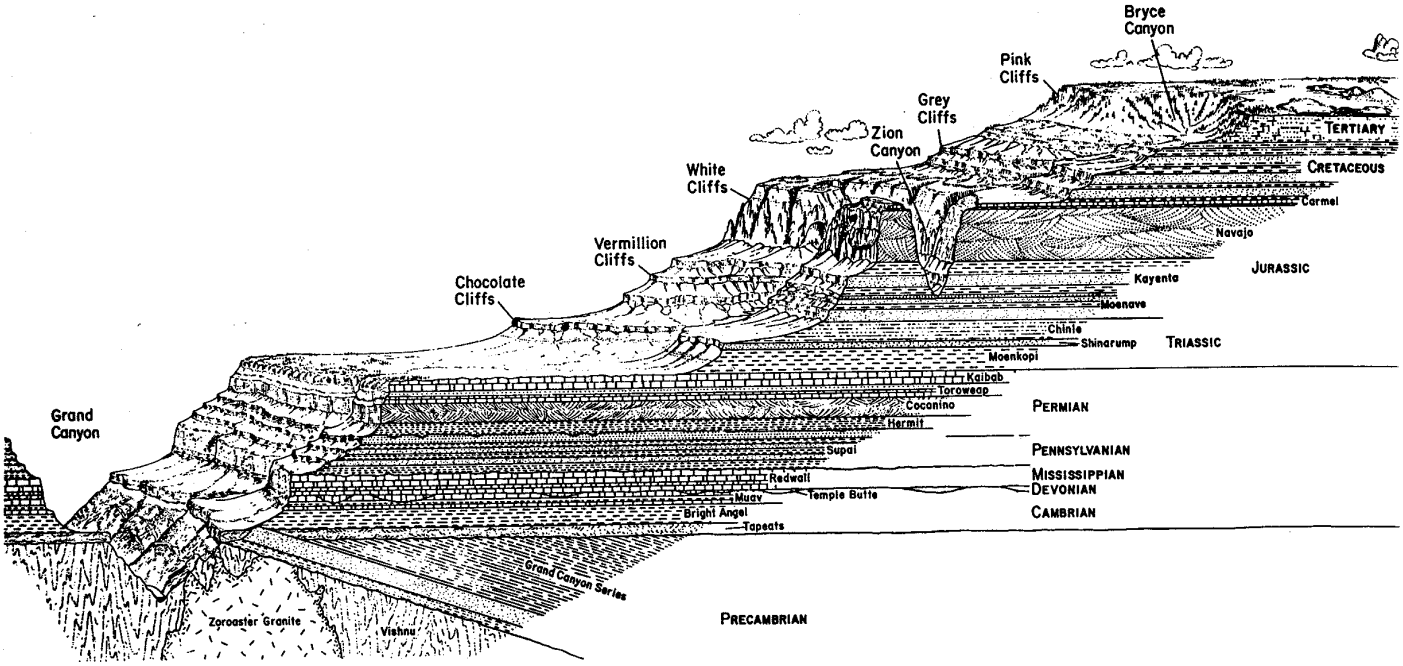


Figure 3-4 Perspective sketch showing the "Grand Staircase" in south central Utah and north central Arizona. Vertical scale greatly exaggerated. Sketch by W.K. Hamblin.

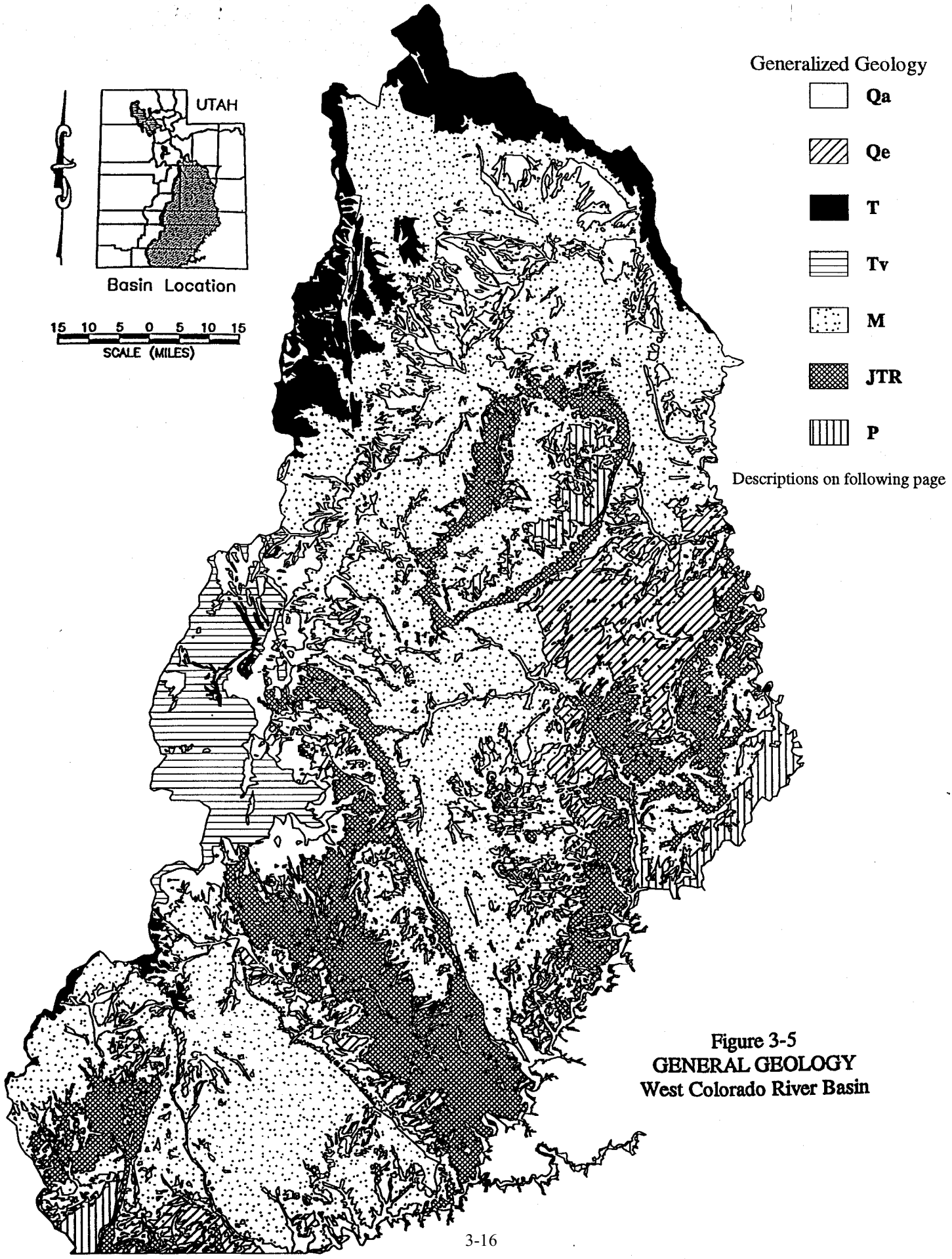


Figure 3-5
GENERAL GEOLOGY
West Colorado River Basin

**Figure 3-5 Legend**

**West Colorado River Basin**
**Generalized Geologic Units**

Quaternary

QaUnconsolidated deposits of alluvium, colluvium, glacial and landslide origin.
QeUnconsolidated deposits of windblown (eolian) origin.

Tertiary

TWeakly to semi-consolidated sedimentary basin-filling rocks of the Bald Knoll, Gray Gulch, Crazy Hollow, Green River, and Flagstaff Formations.

TvIgneous rocks of Tertiary age; includes intrusive rocks of the Henry Mountains and volcanic rocks of the Fish Lake and Boulder Mountain areas.

Mesozoic

MConsolidated sedimentary rocks locally include the North Horn, Price River, Blackhawk, Mancos Shale, Dakota, Morrison, Summerville, Curtis, Entrada,Carmel, Navajo, Kayenta, Wingate, Chinle, Shinarump and Moenkopi Formations.
JTRNavajo Sandstone

Paleozoic

PConsolidated sedimentary rocks locally include the following formations; Kaibab Limestone, White Rim Sandstone, DeChelly Sandstone, Organ Rock Shale, Cedar Mesa Sandstone, Halgaito, Elephant Canyon, Rico, Honaker Trail, Paradox and Redwall Limestone.

basalt, andesite, and latite lava flows and dacitic to rhyolitic ash-flow tuffs. Small areas are covered by unconsolidated eolian and alluvial deposits.

While the Colorado Plateau is characteristically aseismic and lacks the large faults found in the transition zone to the west, the rocks in this basin have suffered much structural deformation. Powerful forces at work in the crust of this area have resulted in the formation of large folds; anticlines, synclines, and monoclines. The two largest such features are the San Rafael Swell (see Figure 3-6) and the Henry Mountains structural basin. Many other smaller features are also present and likewise exert a tremendous influence on the occurrence and movement of surface water and groundwater. Some of these are the Waterpocket Fold, the East Kaibab Monocline, the Cockscomb Ridge, Circle Cliffs Uplift, Caineville Monocline, Teasdale Anticline, and the Saleratus Creek Syncline.

### 3.3.4 Soils, Vegetation and Land Use [3]

Resource data on the soils and vegetation vary in detail, particularly across land ownership and administration boundaries. Land use data vary depending on the purpose for collecting the data and on the methodology used.

**Soils** - Interagency coordination has improved soil surveys. See Figure 3-7 for survey orders and areas. Soil survey information is found in reports available from the Natural Resources Conservation Service, Forest Service and Bureau of Land Management. Soil surveys were conducted at different levels of detail to accommodate the land uses. In general, the information was collected at three levels: 2nd, 3rd and 4th order mapping.

The 2nd order surveys are made for intensive land uses requiring detailed information for making predictions of suitability for use and treatment needs, i.e., croplands areas. The 3rd order surveys are made for land uses not requiring precise knowledge of small areas or detailed soil information, i.e., forest and range lands. The 4th order surveys are made for extensive land uses requiring general soil information for broad statements concerning land use potential and general land management.

The West Colorado River Basin has five climatic soil zones. The zones are summarized in Table 3-5. Generalized soil zone descriptions are:

DESERT CLIMATIC ZONE soils generally have little development and are found on alluvial fans and flood plains. They are dominantly well-drained and somewhat excessively drained.

SEMI-DESERT CLIMATIC ZONE soils in the West Colorado River Basin are quite well developed and are usually found in alluvial deposits and lake sediments. These soils include the ochric and calcic horizons, have a pH of more than 8.0 and are usually very deep. The surface ochric horizons are light in color with little development. Calcic horizons show accumulations of calcium carbonates. Problematic saline and gypsiferous soils are common within this zone, especially in Carbon and Emery counties. The majority of the cropland production occurs in this zone.

UPLAND CLIMATIC ZONE soils have moderate development and are usually found on alluvial fans and hills. The soil features usually include mollic and argillic horizons. Mollic horizons are organically enriched surface layers showing dark colors. Usually this horizon is minimally expressed. The argillic horizon is expressed by textural clay accumulation in the subsoil, which helps contain water in the upper subsoil. These soils have a pH from about 7.5 to 8.0 due to the higher precipitation which leaches the calcium carbonate. The majority of this zone is used for rangeland; only a small amount of it is cropland.

MOUNTAIN CLIMATIC ZONE soils have high development and are usually found on mountain slopes. The soil features include mollic and argillic horizons. Mollic horizons are organically enriched surface layers displaying dark colors. The argillic horizon is expressed by textural clay accumulation in the subsoil, which helps contain water in the upper subsoil. These


**Figure 3-6**

Looking south - Jurassic strata exposed along the east side of the San Rafael Swell near Green River, Utah. Interstate I-70 enters the Swell here. Chinle (Ch) Formation is at the right edge. Light-colored flatirons are Wingate (W) Kayenta (K) and Navajo (N) Sandstones. Carmel (Ca) Formation forms low, dark flatirons. Entrada (E) Formation forms the strike valley. Curtis (Cu) Formation forms the low ridge at left, while the Summerville and Morrison (S) Formations are at the left edge of the photo.

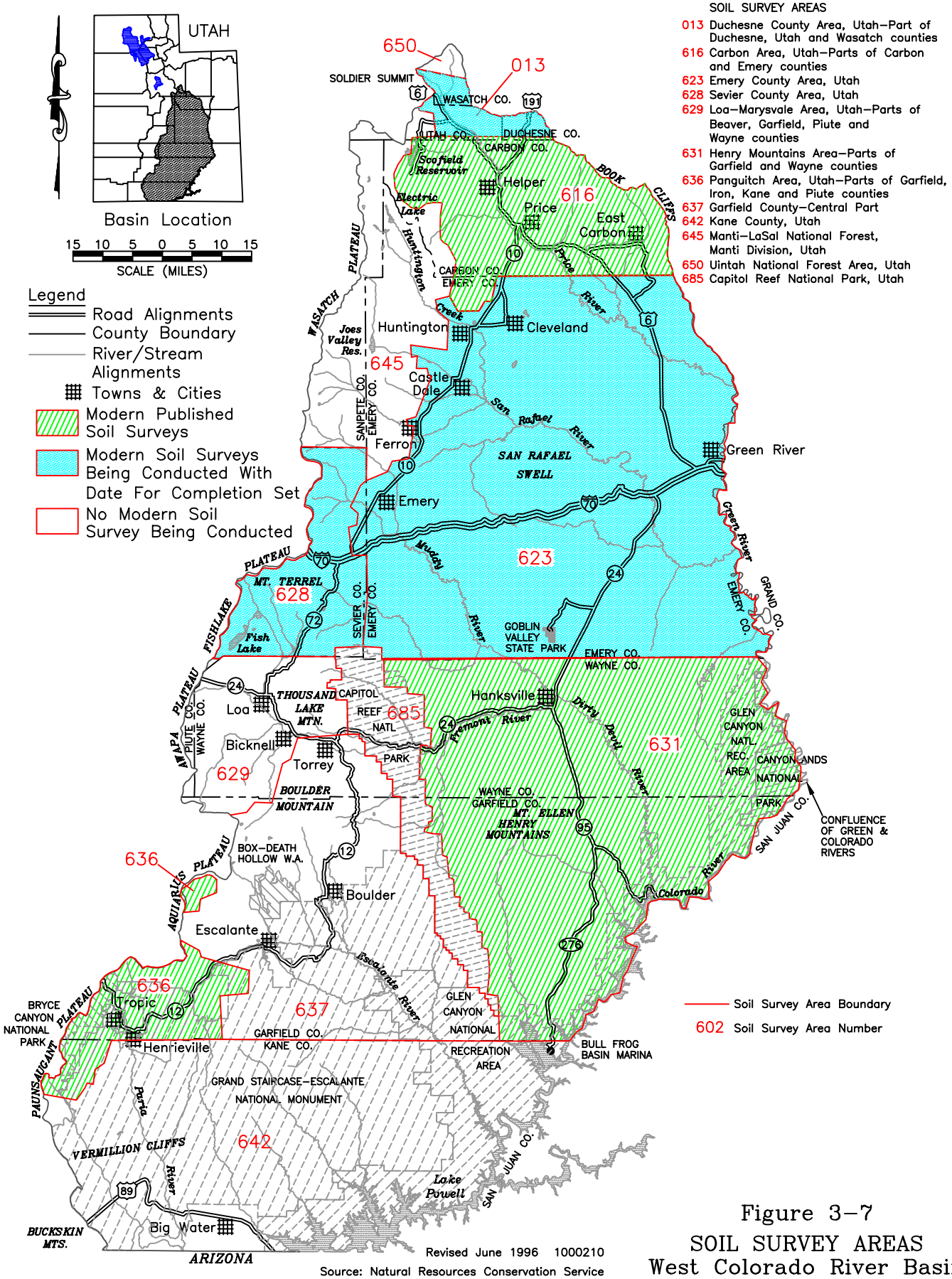


Figure 3–7
SOIL SURVEY AREAS
West Colorado River Basin

**Table 3-5**
**Climatic Zones**

| Climatic Zone | Precipitation (inches) | Temperature (°F) | Freeze-Free Period (days) | Elevation (feet) |
|---|---|---|---|---|
| High Mountain | 22-40 | 34-45 | 40-90 | 8,000-10,000 |
| Mountain | 16-22 | 42-50 | 70-170 | 6,000-8,200 |
| Upland | 12-16 | 45-59 | 120-170 | 4,500-6,900 |
| Semi-desert | 8-12 | 52-59 | 120-190 | 4,500-6,300 |
| Desert | 6-8 | 59-67 | 175-205 | 2,400-4,500 |

soils have a pH of about 7.0 to 8.0 due to the higher precipitation. The majority of this zone is used for rangeland, and there is some timber production.

HIGH MOUNTAIN CLIMATIC ZONE soils have high development and are usually found on mountain slopes and in mountain valleys. The soil features include thick mollic and argillic horizons. Mollic horizons are organically enriched surface layers, well expressed with dark colors. The argillic horizon is expressed by textural clay accumulation in the subsoil which helps contain water in the upper subsoil. These soils have a pH of about 6.0 to 7.5 due to the higher precipitation. The majority of this zone is used for rangeland and timber production.

**Vegetation** - Many vegetative types have been identified in the West Colorado River Basin. Table 3-6 shows the vegetative types within each river system. The vegetative types roughly follow the higher elevations to the valley floors and areas with annual precipitation of 35 inches to lower areas of eight inches.

The conifer-hardwood forest type lies above the 8,000-foot elevation. It consists mostly of white fir, Douglas fir, spruce and quaking aspen. The mountain brush type lies predominantly between 7,500 and 8,500 feet elevation. It consists mainly of gambel oak, serviceberry and curlleaf mountain mahogany. The pinyon-juniper forest type is predominantly pinyon and Utah juniper and it occurs between 5,800 and 7,500 feet elevation. The sagebrush type is found throughout the basin from the desert valley floors up to mountain valleys slopes.

The predominant vegetative communities are salt desert scrub, desert grasslands. These grass vegetative types are found in the semi-desert zone at about 5,000 feet. Other important plants include Indian ricegrass, needle and thread grass, bottle brush, squirreltail, galleta and winterfat.

**Land Use** - The Natural Resources Conservation Service capability groupings show, in a general way, the suitability of the soil for most field crops. Soils are grouped according to their limitations and the way they respond to treatment.

The capability system groups soils at three levels: 1) capability class, 2) sub class, and 3) unit. Capability classes, the broadest group, run from one to eight. The numbers indicate progressively greater limitations and narrower choices for practical uses of agricultural cultivation. Other uses, such as for grazing or wildlife, may not be as restrictive.

The lower numbers are the more choice lands suitable for growing irrigated crops. As the numbers increase, the land becomes more suitable for permanent pasture and progressively to grasslands, forested areas and rocklands. Most of the cropland is found in the first four classes. Lands used for farming can also be defined according to their agricultural production ability and potential.

About 89,000 acres of farmland are currently irrigated; only about 3 percent of the basin area. The balance of the area is used for

**Table 3-6**
**Vegetative Types**

| Vegetative Type | Drainage (acres) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Price | San Rafael | Dirty Devil | Escalante | Paria | Lower Green | Lake Powell | San Juan | Wahweep | TOTAL |
| Water | 2,573 | 2,560 | 4,791 | 1,831 | 0 | 2,780 | 39,788 | 12,995 | 42,155 | 109,473 |
| Alpine | 0 | 6,995 | 18,631 | 14,863 | 0 | 0 | 108 | 0 | 0 | 40,597 |
| Spruce-Fir/Mountain Shrub | 15,038 | 52,222 | 157,279 | 59,619 | 1,791 | 0 | 5,486 | 0 | 51 | 291,486 |
| Ponderosa Pine/Mountain Shrub | 26,762 | 14,567 | 98,697 | 46,686 | 16,351 | 0 | 2,102 | 0 | 951 | 206,116 |
| Mountain Fir/Mountain Shrub | 62,010 | 31,794 | 31,184 | 8,505 | 1,843 | 0 | 1,429 | 0 | 125 | 136,890 |
| Aspen | 80,162 | 76,257 | 63,880 | 25,149 | 482 | 0 | 1,637 | 0 | 0 | 247,567 |
| Aspen/Conifer | 7,330 | 7,069 | 3,949 | 2,898 | 37 | 0 | 121 | 0 | 10 | 21,414 |
| Juniper/Pinyon | 227,246 | 263,854 | 558,702 | 376,813 | 292,513 | 52,773 | 138,533 | 0 | 205,502 | 2,115,936 |
| Oak/Mtn. Mahogany/Mountain Shrub | 38,484 | 33,010 | 45,593 | 14,072 | 16,602 | 53 | 16,165 | 0 | 1,566 | 165,546 |
| Sagebrush/Perennial Grass | 257,353 | 211,455 | 328,179 | 127,004 | 99,189 | 13,280 | 19,241 | 0 | 81,834 | 1,137,535 |
| Grassland/Desert Grassland | 69,600 | 406,771 | 516,243 | 243,683 | 75,939 | 119,907 | 126,078 | 0 | 61,934 | 1,620,155 |
| Meadow | 39,578 | 23,828 | 44,164 | 6,190 | 2,822 | 0 | 349 | 0 | 3,238 | 120,169 |
| Mountain Riparian | 1,263 | 2,320 | 1,974 | 877 | 104 | 0 | 157 | 0 | 0 | 6,695 |
| Lowland Riparian | 2,162 | 2,898 | 764 | 692 | 220 | 3,587 | 101 | 0 | 1,074 | 11,498 |
| Salt Desert Scrub/Rangeland Brush | 339,112 | 337,020 | 753,985 | 307,229 | 125,807 | 333,376 | 486,937 | 0 | 449,795 | 3,133,261 |
| Lava | 0 | 0 | 67 | 0 | 0 | 0 | 0 | 0 | 0 | 67 |
| Barren | 5,657 | 51,355 | 127,015 | 49,718 | 27,945 | 9,285 | 29,347 | 0 | 10,097 | 310,419 |
| Agriculture | 26,697 | 30,278 | 29,454 | 6,597 | 2,945 | 3,250 | 0 | 0 | 0 | 99,221 |
| Urban | 3,803 | 2,147 | 2,204 | 502 | 413 | 493 | 48 | 0 | 154 | 9,764 |
| TOTALS | 1,204,830 | 1,556,400 | 2,786,755 | 1,292,928 | 665,002 | 538,784 | 867,627 | 12,995 | 858,486 | 9,783,809 |

Source: Utah Division of Wildlife Resources

rangeland, although some higher rockland areas are unsuitable for grazing. Forest resources found in many areas provide opportunities for commodity production in addition to utilizing the grazing resource.

### 3.3.5 Land Status

The total area of the West Colorado River Basin is nearly 10 million acres. The hydrologic study areas are shown in Table 3-7. The federal government has the responsibility to administer about 86 percent of the lands in the basin. The state administers about 6 percent and 8 percent is privately owned. The breakdown of land ownership and administration is shown in Table 3-8. The federally administered land is under the jurisdiction of three agencies: 1) Forest Service, 2) Bureau of Land Management, and 3) National Park Service. Table 3-9 shows the areas under each of these jurisdictions.

## 3.4 Water-Related History [6]

As the early settlers began moving into the basin, they immediately dug ditches and built small storage facilities to irrigate their croplands. Soon after settlement, the effects of changes in land use began to appear near expanding communities, particularly in the Wasatch Plateau. Timber harvesting and grazing by increasing numbers of livestock began to weaken the vegetation holding the friable soil on steep slopes causing erosion of upland range. Loss of vegetation and gullying of slopes had the hydrologic effect of increasing flood peaks and decreasing base flow in streams upon which irrigators depended. As the result of pressure from western farmers and ranchers, Congress passed the Forest Reserve Act of 1891 and the Organic Act of 1897 under which forest reserves could be set aside for the protection of timber resources and watersheds. Congress established the Forest Service in 1905, giving it the responsibility to manage the forest reserves for multiple use purposes.

Comprehensive management evolved slowly until the widespread floods of the 1920s and 1930s. In the 1930s, federal assistance under the CCC and the Works Project Administration was applied to large scale watershed rehabilitation projects on the Manti National Forest as well as other forests in Utah. The Taylor Grazing Act of the 1930s restricted grazing on Public Domain lands. By 1950 the Forest Service and the Bureau of Land Management aggressively reduced livestock numbers on public lands. The decrease in mud flows and damaging floods since 1940 can be at least partly attributed to multiple-use land management, although variations in climate may have also played a part.

As the settlements grew, they collected spring water and dug wells for their culinary (domestic) water needs. These early developments, although small, provided then and still provide a portion of the water supply in the basin. Some larger projects which provide the majority of the current water supply are major contributors to the economic life of the basin.

**Price River/San Pitch River Developments**

Irrigation concerns in Sanpete County were addressed as early as 1867 when the Fairview Lakes were constructed. Water was first delivered from the lakes to Cottonwood Canyon by way of a ditch that discharged into the White Pine Fork of the Sevier River Basin. The Mammoth Reservoir Company was incorporated and made filings on the flood waters of the Price River in 1896. A group of San Pitch River (Sevier River Basin) farmers obtained the rights of the company in 1900 to store water on Gooseberry Creek and convey it by transmountain diversion to their lands. During 1902, they had financial difficulties and the project passed into the hands of the Irrigated Lands Company. This company abandoned the transbasin diversion and made plans to irrigate 25,000 acres near Price. The company borrowed money from the state of Utah and proceeded with construction of Mammoth Dam. Financial difficulties caused the Irrigated Lands Company to be reorganized in 1911 to form the Price River Irrigation Company. They built the Mammoth Dam approximately 100 feet downstream of the present Scofield Dam. The dam failed in June 1917 before it was finished, releasing about 11,000 acre-feet of water and causing flood damage estimated at $1 million to railroad and mining property. The dam was never rebuilt.

The first Scofield Dam on Price River was completed in 1926 by the Price River Water Conservation District, forming a 61,000 acre-foot capacity reservoir to replace the Mammoth Reservoir. The Scofield Dam partially failed in 1928 when the reservoir filled for the first time.

## Table 3-7
## Land Areas

| Sub-Basin | COUNTY | | | | | | | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Utah | Wasatch | Sanpete | Duchesne | Carbon | Emery | Grand (acres) | Sevier | Piute | Wayne | Garfield | Kane | San Juan | |
| Price | 69,075 | 39,742 | 31,118 | 22,911 | 612,180 | 428,276 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,203,302 |
| San Rafael | 0 | 0 | 143,660 | 0 | 3,558 | 1,381,813 | 0 | 0 | 0 | 26,302 | 0 | 0 | 0 | 1,555,333 |
| Dirty Devil | 0 | 0 | 38,157 | 0 | 0 | 609,662 | 0 | 363,053 | 18,051 | 1,324,246 | 431,313 | 0 | 0 | 2,784,482 |
| Escalante | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,348 | 1,007,380 | 285,588 | 0 | 1,294,316 |
| Paria | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 152,793 | 512,775 | 0 | 665,568 |
| Lower Green | 0 | 0 | 0 | 0 | 0 | 316,193 | 1,473 | 0 | 0 | 214,832 | 3,038 | 0 | 0 | 535,536 |
| Lake Powell | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,334 | 763,461 | 100,995 | 0 | 873,791 |
| Wahweep | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10,200 | 848,287 | 0 | 858,487 |
| San Juan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,995 | 12,995 |
| TOTAL | 69,075 | 39,742 | 212,935 | 22,911 | 615,738 | 2,735,944 | 1,473 | 363,053 | 18,051 | 1,576,062 | 2,368,185 | 1,747,645 | 12,995 | 9,783,809 |

## Table 3-8
## Land Ownership and Administration

| Status | COUNTY | | | | | | | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Utah | Wasatch | Sanpete | Duchesne | Carbon | Emery | Grand (acres) | Sevier | Piute | Wayne | Garfield | Kane | San Juan | |
| Private | 49,848 | 13,683 | 12,448 | 15,701 | 284,363 | 234,848 | 1,473 | 20,791 | 122 | 56,240 | 55,897 | 25,519 | 0 | 770,933 |
| State | 3,155 | 163 | 2,709 | 5,955 | 76,840 | 289,745 | 0 | 16,026 | 16,437 | 191,030 | 192,257 | 223,823 | 0 | 1,018,140 |
| Federal | 16,072 | 25,896 | 197,778 | 1,255 | 254,535 | 2,211,351 | 0 | 326,236 | 1,492 | 1,328,792 | 2,120,031 | 1,498,303 | 12,995 | 7,994,736 |
| TOTAL | 69,075 | 39,742 | 212,935 | 22,911 | 615,738 | 2,735,944 | 1,473 | 363,053 | 18,051 | 1,576,062 | 2,368,185 | 1,747,645 | 12,995 | 9,783,809 |

## Table 3-9
## Federal Land Administration

| Agency | COUNTY | | | | | | | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Utah | Wasatch | Sanpete | Duchesne | Carbon | Emery | Grand (acres) | Sevier | Piute | Wayne | Garfield | Kane | San Juan | |
| Forest Serv. | 9,219 | 25,896 | 197,778 | 58 | 31,913 | 210,327 | 0 | 246,520 | 272 | 160,165 | 446,775 | 11,203 | 0 | 1,340,126 |
| Bureau of Land Mgmt. | 6,853 | 0 | 0 | 1,197 | 222,622 | 1,998,705 | 0 | 74,414 | 1,220 | 894,028 | 1,253,710 | 1,116,355 | 0 | 5,569,104 |
| Nat'l Park | 0 | 0 | 0 | 0 | 0 | 2,319 | 0 | 5,302 | 0 | 274,599 | 419,546 | 370,745 | 12,995 | 1,085,506 |
| TOTAL | 16,072 | 25,896 | 197,778 | 1,255 | 254,535 | 2,211,351 | 0 | 326,236 | 1,492 | 1,328,792 | 2,120,031 | 1,498,303 | 12,995 | 7,994,736 |

Source: Utah Geographic Reference Center

Storage in the reservoir was thereafter restricted by the state engineer to a maximum content of 20,000 acre-feet until 1936 and 30,000 acre-feet after that.

In 1933 the Bureau of Reclamation recognized the need to develop a comprehensive water development plan on the Price River System to meet the water needs of Carbon and Sanpete (Sevier River Basin) counties. The plan evolved to become known as the Gooseberry Project Plan. Originally the Gooseberry Project Plan included three major features: (1) A dam on Gooseberry Creek with feeder canals from Brooks Canyon and Cabin Hollow Creeks, (2) a transmountain tunnel, and (3) an enlarged Scofield Reservoir to provide water by exchange to support a transmountain diversion of water for the dam site on Gooseberry Creek.

Scofield Reservoir

Replacement of Scofield Dam was expedited during World War II because potential failure of the existing dam posed a threat to the war effort. The Scofield Project was completed in 1946 and replaced the existing unsafe dam to stabilize the water supply in Carbon County. In addition, the reservoir storage capacity was enlarged to store surplus flows so that the remainder of the Gooseberry Project Plan could be completed.

A plan to complete the Gooseberry Project was formulated in 1953 by the Bureau of Reclamation. In 1964 a transmountain tunnel (the Narrows Tunnel) was constructed with a loan from the Utah Board of Water Resources. After the tunnel was completed, controversy developed over the use of Gooseberry Creek water for the transmountain diversion and further work on the plan came to a halt. Acceptance of the 1999 Environmental Impact Statement is currently holding up the project.

**Emery County Project**

Natural flows from Huntington Creek were first appropriated in 1876 when small ditches were dug to divert water onto about 320 acres of land. Canals were constructed in 1878 to divert irrigation water from Cottonwood and Huntington creeks. By about 1900, all dependable natural flows of the two creeks had been appropriated. The individual canal companies of the Huntington area consolidated in 1932 into the Huntington-Cleveland Irrigation Company. The small companies in the Cottonwood area joined in 1937 to form the Cottonwood Creek Consolidated Irrigation Company.

Wide seasonal fluctuations in available water supply led to inefficient irrigation practices in much of Emery County. Plans were investigated in the late 1940s to early 1950s to alleviate this problem, resulting in the Emery County Project which was completed by the Bureau of Reclamation in 1966.

The Emery Water Conservancy District was formed April 4, 1961 by order of the Seventh Judicial District Court of the state of Utah in and for Emery County. It serves as a general contracting and administrative agency for the Emery County Project. The Huntington-Cleveland Irrigation Company and the Cottonwood Creek Consolidated Irrigation Company purchase project water from the conservancy district which distributes it into the canals in their systems. The Emery County Project provided further storage regulation of the flows of Cottonwood and Huntington creeks in order to increase the irrigation water supply for 18,004 acres of land and provide a full supply for 771 acres of new land. The project also provided benefits to recreation and fish and wildlife.

The principal project storage is the 62,500-acre-foot Joes Valley Reservoir that is formed by a dam on Seeley Creek, a major tributary of Cottonwood Creek. Water is released from the reservoir as needed for irrigation flows in Seeley Creek to Cottonwood Creek, from which it is diverted for distribution by the existing canals and by the

project's new Cottonwood Creek-Huntington (CC&H) Canal. This canal delivers project water to the Huntington Canal, the North Ditch and some private ditches, all of which divert from Huntington Creek. Other project water in Cottonwood Creek is distributed through the Blue Cut and Great Western canals and private ditches diverting from the creek.

Huntington Creek water available through the project is diverted through the North Ditch to the Huntington North Reservoir located adjacent to Highway 10 about one mile northeast of Huntington, Utah. The reservoir has a capacity of 5,420 acre-feet. The stored water is released as needed into the Huntington North Service Canal in which it is returned to the North Ditch and may also be conveyed to the south branch of the Cleveland Canal. Some lands irrigated from Huntington Creek that are at a higher elevation than the Cottonwood Creek-Huntington (CC&H) Canal are irrigated by the Cleveland Canal. These lands receive additional water from Huntington Creek in exchange for replacement project water delivered to lands below the CC&H Canal.

Not all of the acres presently irrigated in the Emery Project area received project water. Some of the lands already had a full water supply, and other lands were not productive enough to justify additional water.

Project irrigators were to limit early-season diversions under pre-project water rights in order to make more water storable for late season use and to impede damaging water accumulations in parts of the project area. The irrigators also planned to improve irrigation efficiencies by rotating water turns and discontinuing the practice of a constant division of the available stream flow along laterals on a percentage basis. The project also included lining of some of the existing canals.

Fishery benefits were provided at Joes Valley and Huntington North reservoirs. Four small reservoirs above the Joes Valley site, with combined capacities of about 264 acre-feet, were acquired by the project and maintained at constant water elevations for fishery purposes. Replacement storage for these reservoir owners was provided in

Joes Valley Reservoir

the reservoir. Minimum flows of 10 cfs in the creek channel below Joes Valley Reservoir will be maintained for domestic and stock-watering use. Private lands above Joes Valley Reservoir were acquired and national forest lands were improved in order to replace the big game grazing range within the reservoir basin.

The Bureau of Reclamation constructed the recreational facilities at Joes Valley Reservoir. The Forest Service now maintains and operates the campground, picnic area and boat launch facilities. Limited recreational facilities at Huntington North Reservoir were originally planned by the National Park Service. The state now maintains and operates Huntington State Park, which consists of a campground, picnic area and boat launch facilities.

In the 1960s, Utah Power (previously Utah Power and Light Company) began purchasing shares of stock in the Cottonwood Creek Consolidated Irrigation Company and the Huntington Cleveland Irrigation Company to use for process water for power generation at the proposed Huntington coal-fire plant. Utah Power also obtained 6,000 acre-feet of project water and also has primary water shares in the Ferron Canal and Reservoir Company.

Utah Power completed the Huntington coal-fire plant in 1977 with two units (845,000 kw) and began generating power. Later the Hunter plant was completed in 1987 with coal/fire/steam generation units. At that time the company obtained another 2,574 acre-feet of project water to firm up a water

supply for a third unit at the Hunter plant. The third unit was completed in 1983, and the Hunter plant has a present power generation capacity of 1,240 mw.

Utah Power is now using 8,574 acre-feet of project water as well as its primary water rights in Cottonwood, Huntington and Ferron creeks for power production at the Huntington and Hunter power plants. The use of water for power production by Utah Power has resulted in a decrease in the salt loading to the Colorado River.

**Ferron Watershed Project**

Millsite Reservoir (funded by the Board of Water Resources) was completed in 1971 as part of the Ferron Watershed Project under the authority of the Watershed Protection and Flood Prevention Act. This project was designed by the U.S. Soil Conservation Service (now the Natural Resources Conservation Service) and included upgrading water quality, sediment and flood retention, irrigation distribution, and rangeland stabilization of the Ferron Creek drainage. The 18,000 acre-foot reservoir's primary function is to provide irrigation storage; however, it also provides a conservation pool for fish, recreational opportunities, and serves local municipal and industrial water needs. The Hunter Power Plant receives about 30 percent of its water from this facility. Other smaller reservoirs were also built, as well as the recreational facilities at Millsite State Park, as part of this watershed project.

Millsite Reservoir

Under the Ferron Watershed Project, eight debries basins and a livestock pipeline to replace the use of Ferron Creek for livestock water were also constructed. Three reservoirs in the upper watershed (Duck Fork, Willow Lake and Ferron Reservoir) were converted from irrigation storage to fisheries. About 10 percent of the Ferron irrigation system was improved (earth ditches converted to pipeline). The upper watershed was treated by the Forest Service to improve vegetative cover.

**Electric Lake**

Electric Lake, completed in 1973, is owned by Utah Power. The 31,500 acre-foot reservoir was built to provide water storage for use in the company's Huntington Power Plant. Other than a constant fishery release and an obligation to release lease-back privileges to farmers affected by the power plant, most of the water for the plant is released on call.

Electric Lake

**Wayne County Developments**

In the late 1800s, many ditches and canals were built for irrigation in the vicinities of Fremont, Loa and Bicknell. The Fremont Irrigation Company (FIC) was formed in 1889 to "promote good feelings among the water users of Fish Lake and the Fremont River and to manage such waters." Fish Lake was purchased in 1889 by the FIC from the Paiute Indians. The FIC first built the Thurber Canal (now the Highline Canal) and then in 1890 negotiated with

Forsyth Reservoir

Johnson Valley ranchers for the purchase of their land to construct Johnson Valley Reservoir, completed in 1899. A controversy over water rights between stockholders and non-stockholders began. The McCarthy Court Decree of 1902 and the construction of Forsyth Reservoir (completed in 1917) were the solutions to the dispute. Forsyth Dam washed out in 1921, but was rebuilt in 1925. Mill Meadow Dam was built in 1955 for the irrigation company and financed by the Utah Water and Power Board (now the Utah Board of Water Resources).

Farmers around Teasdale built several small reservoirs on Donkey Creek and Bullberry Creek. In 1950 the dam on Bullberry Creek washed out; it has never been rebuilt. Farmers in and around Grover began irrigating lands in 1893 and built outlet structures on Fish Creek Lake to draw more water out of this small natural lake.

Between 1955 and 1985, the U. S. Agricultural Stabilization and Conservation Service (ASCS) and the Utah Board of Water Resources provided funding for the conversion of flood irrigation practices to sprinkler irrigation. Western Wayne County is one of the first areas of the state where all of the farmland was completely converted to sprinkler irrigation.

**Garfield County Developments**

Wide Hollow Reservoir was built by the New Escalante Irrigation Company in 1954. It was designed by the Soil Conservation Service (now Natural Resources Conservation Service) and financed by Farmers Home Administration. It originally held 2,400 acre-feet of water, but sedimentation has reduced its capacity to 1,400 acre-feet. Presently, there is a plan to reduce the capacity of Wide Hollow to 400 acre-feet and construct a new reservoir of between 4,000 to 6,000 acre-feet (see Section 9).

North Creek Reservoir was originally completed in 1932. This dam immediately failed, and a new dam was completed in 1941. About 400 acre-feet of water is stored for irrigation use by the New Escalante Irrigation Company, and recreation is also provided. Jacobs Reservoir was constructed in 1911. It contains 1,967 acre-feet of storage for the Pine Creek Irrigation Company which is used to irrigate lands just north and east of Escalante.

Several small lakes used for irrigation are above the town of Boulder. Spectacle Lake Reservoir dam was originally constructed in 1932 and raised 10 feet in 1934. The dam failed in 1938, and repair and improvement was completed in 1949 with financial help from the Utah Water and Power Board (now Utah Board of Water Resources). The dam was repaired in 1991. A third of the costs were paid by Garkane Power Association, Inc., which used this water source for hydropower production. McGath

Wide Hollow Reservoir

Lake Dam was built in 1896 and stores water for use in the Salt Gulch area west of Boulder. Most of the agricultural lands around Boulder have been put under sprinkler irrigation.

Tropic Reservoir (capacity 1,850 acre-feet) was built on the East Fork of the Sevier in 1901 to provide irrigation water for use in Bryce Valley (Tropic area). The reservoir also supplies water to Otter Creek Reservoir in the Sevier River Basin. A canal was constructed and today flows through Bryce Canyon National Park to the town of Tropic. The dam's spillway washed out in 1935. In 1936 the dam was reconstructed. The dam and reservoir are owned by the Tropic and East Fork Irrigation Company. This import into the West Colorado River Basin is the only major import into the entire Colorado River system.

**Lake Powell**

On October 15, 1956, President Dwight D. Eisenhower pushed a button at his White House desk, initiating the blast that started construction of the Glen Canyon Dam in Arizona eight miles south of the Utah border. This put in motion a mammoth building project by the Bureau of Reclamation to harness the power of the Colorado River. A knowledge of its history is essential in understanding the West.

The dam and reservoir were built as part of the Colorado River Storage Project and was needed to assure that the Upper Basin states could meet their Lower Basin delivery obligations under the 1922 Colorado River Compact without curtailing Upper Basin uses. The dam is 580 feet high and impounds 26 million acre-feet of water. The dam and associated 800-megawatt plant are operated by the Bureau of Reclamation. The dam has backed up the flows of the Colorado and San Juan rivers 186 miles and 71 miles respectively, creating 1,960 miles of shoreline (more than along the entire New England coast). It is one of the largest man-made lakes in the United States.

Forecasters estimated in the 1950s that Lake Powell would have up to a half-million visitors during a year; it now receives visitation like that on Labor Day weekend alone. Some come to fish, others to swim and boat, still others to explore; but all come to enjoy the red rock, sand and sun for which Lake Powell is famous. Marinas located at Page, Wahweap, Bullfrog, Hall's Crossing and Hite sit on land that used to be visited only by Navajos, Paiutes and an occasional white man, but now serve millions of people.

**Colorado River**

The steep and turbulent Colorado River falls more than 12,000 feet in its 1,440-mile course from the Rocky Mountains in Colorado and Wyoming to its natural outlet in the Gulf of California. The river has a huge drainage basin that covers over 244,000 square miles located in parts of seven states and Mexico. The seven states are referred to as the Colorado River Basin states and comprise about one-twelfth of the area of the continental United States. (See Figure 3-8.) Despite the size of the watershed, the Colorado River ranks only sixth among the nation's rivers in volume of flow with an average annual undepleted flow in excess of 17.5 million acre-feet (15 million acre-feet at Lee Ferry, the compact division point). In comparison, the Columbia River's drainage is about the same size but its flow is about 12 times greater. Demands on the Colorado River are not limited to needs within the Colorado River Basin. In fact, more water is exported from the basin than from any other river system in the country. The Colorado River provides municipal and industrial water for more than 20 million people living in the major metropolitan areas of Los Angeles, Phoenix, Las Vegas, Salt Lake City,

Rainbow Bridge National Monument, Lake Powell

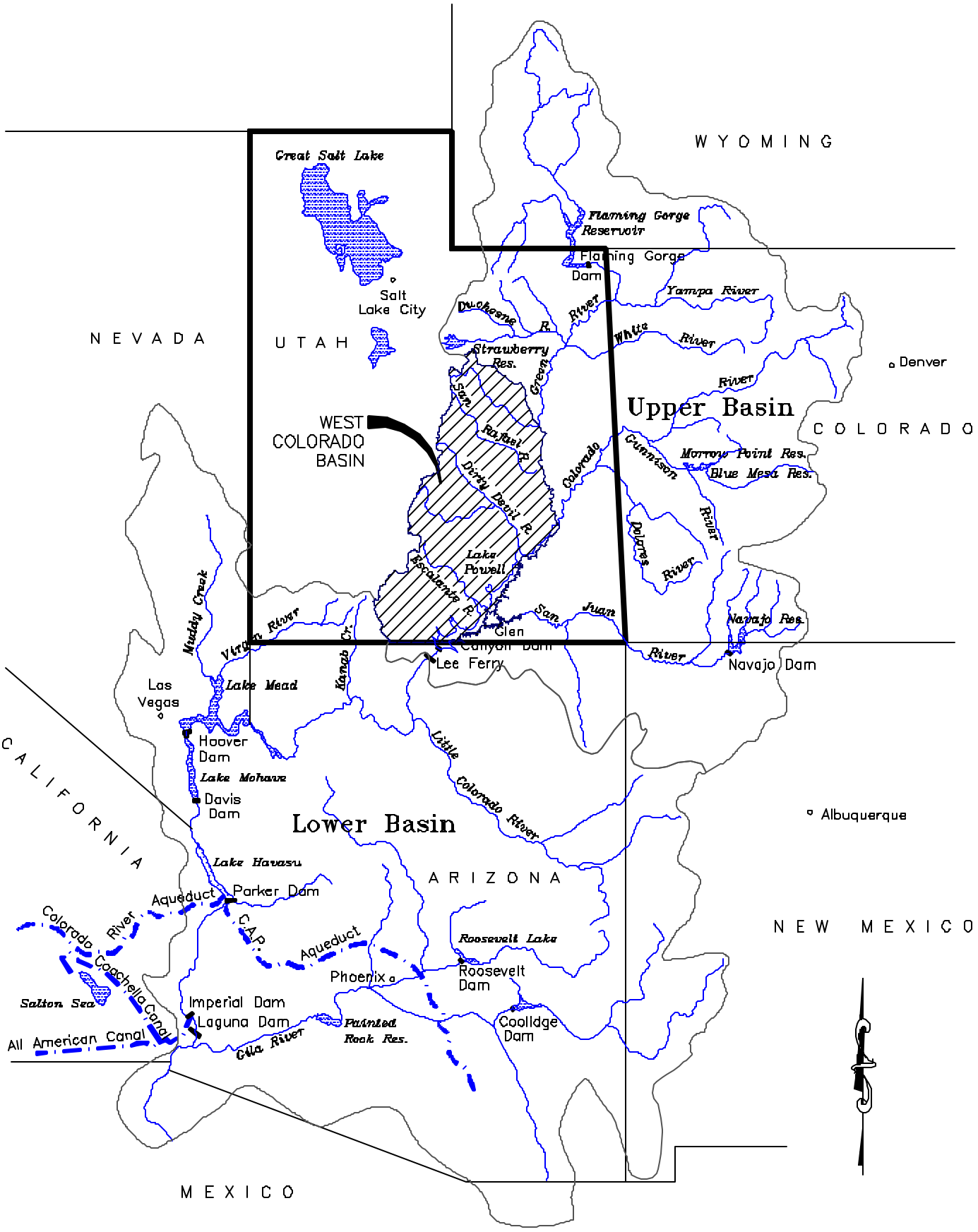


Figure 3-8
COLORADO RIVER DRAINAGE BASIN
West Colorado River Basin

Denver, San Diego and hundreds of other communities in the seven states. It also provides irrigation water to more than 1.5 million acres of land. The river has more than 60 million acre-feet of storage capacity (most is in Lake Powell and Lake Mead), 4,000 megawatts of hydroelectric-generating capacity and provides more than 20 million annual visitor-days of outdoor recreation.

Because of the critical role of water to all social and economic activity in the arid West, the Colorado River has been the subject of extensive negotiations and litigation. From this has developed a complex set of federal laws, compacts, court decisions, treaties, state laws and other agreements collectively known as "The Law of the River". The principal historical documents forming the "Law of the River" are:

- Colorado River Compact of 1922,
- Boulder Canyon Project Act of 1928,
- Mexican Treaty of 1944,
- Upper Colorado River Basin Compact of 1948,
- Colorado River Storage Project Act of 1956,
- U.S. Supreme Court Arizona v. California decision (1963),
- Colorado River Basin Project Act of 1968,
- Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs of 1970,
- Minute 242 of the 1973 International Boundary and Water Commission,
- Colorado River Basin Salinity Control Act of 1974,
- The Grand Canyon Protection Act of 1992.

**Dividing the River** - The Colorado River is often described as the most regulated river in the world. Considering its importance to the basin states, American Indian Tribes and Mexico, it is surprising any agreement has been reached to divide the river's water.

In the late 1800s and early 1900s, a sizeable agricultural development emerged in California's Imperial Valley. Water was delivered to the valley from the Colorado River through a canal that went through Mexico. Mexico allowed Imperial Valley farmers to use the channel in exchange for a portion of the water. American farmers were unhappy with the Mexican government controlling their water supply from the river, so they began to push for the construction of a new canal built entirely within the United States, an "All American" canal. Disastrous flooding occurred in 1905 along the Colorado River. The river broke through a temporary diversion through the river bank and for two years the entire flow of the river poured into the Imperial Valley before it could be diverted back to the river channel. The flooding destroyed homes and thousands of acres of agricultural land, filling a natural depression known as the Salton Sink and creating today's Salton Sea. As additional flooding occurred in 1910 and the Mexican Revolution began, pressure intensified to construct an All-American canal to bring Colorado River water to the valley and build a flood control dam and storage reservoir on the lower mainstem Colorado River. In addition, Los Angeles was interested in developing hydroelectric power to meet needs of its growing population.

California realized construction of a project to harness the river would require the federal government's assistance, which would raise legal and political issues. The other six basin states did not oppose structural control of the river but were determined to resist a project for California, unless they received satisfactory assurance of their future use of the river's water. Such use by California, they feared, would establish appropriative claims to the water (first in time, first in right) and would prejudice the equity of any future apportionment of the Colorado River among the states. The solution appeared to be the development of an interstate compact between the basin states that would detail the division of the water in the Colorado River.

**1922 Colorado River Compact** - Compact discussions began on January 26, 1922, and on November 24, 1922, the basin states and federal government compact negotiators approved the Colorado River Compact. The compact split the river system into an Upper Basin (Arizona, Colorado, New Mexico, Wyoming and Utah) and a

Lower Basin (Arizona, California, Nevada, New Mexico and Utah) and apportioned the rights to the water between Lower and Upper basins. The dividing line and measuring point was at Lee Ferry, approximately 17 miles below Glen Canyon Dam and two miles below the confluence with the Paria River. (The gage is actually at Lees Ferry, about four miles upstream of Lee Ferry.) The compact apportioned from the Colorado River in perpetuity to the Upper and Lower basins the exclusive, beneficial consumptive use of 7.5 million acre-feet of water per annum. The Upper Basin agreed to guarantee the Lower Basin an average of 75 million acre-feet in any consecutive 10-year period. In addition, the Lower Basin received the right to increase its annual beneficial consumptive use of water by 1.0 million acre-feet. Even though the compact negotiators were unsuccessful in their attempt to divide the water between the individual states as originally intended, the compact reduced the Upper Division states' concern that the faster-growing Lower Division states would monopolize use of the Colorado River. The compact set aside the prior appropriation doctrine of "first in time, first in right" and allowed each basin to develop its apportioned water as needed without fear of losing it through non-use. The compact side-stepped quantification of Indian water rights.

The Arizona legislature, in contrast to other basin states, refused to ratify the compact because it felt the compact left Arizona unprotected against rapid development in California. Arizona also opposed including tributary water (specifically the Gila River) in the compact's apportionment. Because of Arizona's refusal to approve the compact, Congress did not ratify the compact until 1928 when the Boulder Canyon Project Act was passed. The act allowed the compact to become law with the approval of six states and the enactment by California of a statute limiting its use of Colorado River water. Arizona finally ratified the compact in 1944. The California Self Limitation Act was passed March 4, 1929. It provides that: "...the State of California agrees irrevocably and unconditionally with the United States and for the benefit of the states of Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming as an express covenant and in consideration of the passage of the said Boulder Canyon Project Act that the aggregate annual consumptive use of water of and from the Colorado River for use in the State of California ... shall not exceed four million four hundred thousand acre-feet of the waters apportioned to the lower basin states by Paragraph A of Article 3 of the said Colorado River Compact, plus not more than one-half of any excess or surplus waters unapportioned by said compact..."

For clarity, the 1922 Colorado River Compact says the term "states of the Upper Division" means the states of Colorado, New Mexico, Utah and Wyoming, and the term "states of the Lower Division" means the states of Arizona, California and Nevada. It further says the term "Upper Basin" means those parts of the states of Arizona, Colorado, New Mexico, Utah and Wyoming within and from which waters naturally drain into the Colorado River system above Lee Ferry. The term "Lower Basin" means those parts of the states of Arizona, California, Nevada, New Mexico and Utah within and from which waters naturally drain into the Colorado River system below Lee Ferry. (See Figure 5-1.)

**Water for Mexico** - The last 75 miles of the Colorado River is in Mexico, where the water is used for irrigation. Mexico's share of the Colorado River is determined under provisions of a treaty signed in 1944. The treaty guarantees Mexico 1.5 million acre-feet to be increased in years of surplus to 1.7 million acre-feet and reduced in years of extraordinary drought in proportion to the reduction of consumptive uses in the United States. No mention was made in the treaty about water quality, but a subsequent agreement between the United States and Mexico, called "Minute 242, International Boundary and Water Commission, September 4, 1973," contains a provision guaranteeing Mexico water within certain water quality parameters.

The water delivered at the international boundary must have an average annual salinity of no more than 115 (±30) ppm over the salinity of water which arrives at Imperial Dam. The Salinity Control Act was passed in 1974, authorizing the use of federal funds to help control salinity in the Colorado

River. Title I of the act authorized construction of a desalination plant near Yuma, Arizona, to desalt 80,000 acre-feet of return irrigation flows from farms in the Welton Mohawk Irrigation District prior to the water being diverted by Mexico. The desalting plant was completed in 1992 at a cost of $250 million. Because of the high annual operating cost of over $25 million, the plant is not being operated at the present time. Title II of the act and subsequent amendments authorized federal agencies to cost share with state and local organizations for the construction of projects, mostly in the Upper Basin, to control the salinity of the river by decreasing the amount of salt entering the river. One of the projects in Utah funded by the program is the Uintah Basin Salinity Control Project, where the irrigation efficiency on approximately 94,000 acres of farm land has been improved by implementing land leveling, border irrigation or converting from flood to sprinkler irrigation practices. This has resulted in the reduction of over 84,000 tons/year of salt entering the Colorado River. A new project in the Price-San Rafael drainage of the West Colorado River Basin has recently been authorized. As improvements are made, significant results are expected here as well.

**Upper Colorado River Basin Compact** - Formal negotiations on an Upper Colorado River Basin Compact were initiated on July 31, 1946. They were prompted by the desire of the Upper Basin states to continue water development which had been put on hold in 1941 by wartime restrictions. The Upper Basin states wanted to construct a major federal project, but federal funding was contingent on an Upper Colorado River Basin Compact. On October 11, 1948, the Upper Basin states entered into the Upper Colorado River Basin Compact to apportion allowable depletions between the states. The four Upper Division states were uncertain how much water would remain after they met their Colorado River Compact requirement to deliver the Lower Division 7.5 million acre-feet per annum and how the Mexican Treaty obligation might affect the available water supply. So they apportioned the remaining water as follows: Colorado, 51.75 percent; New Mexico, 11.25 percent; Utah, 23.00 percent; Wyoming, 14.00 percent; Arizona, 50,000 acre-feet (deducted prior to calculating other state shares).

The Upper Colorado River Basin Compact gave the states the final protection they needed in order to develop and use their water gradually, without fear of losing it through non-use.

**Boulder Canyon Project Act** - Even though Arizona refused to ratify the Colorado River Compact until 1944, it became law in 1929 with the passage of the Boulder Canyon Project Act. This act authorized construction of the All-American Canal, Hoover Dam and Power Plant, and gave Arizona, California and Nevada the option of developing a Lower Basin Compact to divide their Colorado River Compact apportionment. The Lower Division states were never able to agree on the division of the water, and the final apportionment was not decided until the Supreme Court ruled in Arizona v. California in 1963.

Arizona v. California - In 1963, after 11 years of legal battles, the U.S. Supreme Court, in its decision in Arizona v. California, confirmed the 1928 Boulder Canyon Project Act Lower Division apportionment of mainstem Colorado River as: California 4.4 million acre-feet and 50 percent of all surplus, Arizona 2.8 million acre-feet and 46 percent of all surplus, and Nevada 300,000 acre-feet and 4 percent of all surplus. The court also held that Arizona's use of the Gila River and its tributaries would not reduce its entitlement of 2.8 million acre-feet from the mainstem Colorado River.

The 1908 Winters v. United States Supreme Court decision established the doctrine of Indian reserved water rights. The courts held that such rights existed whether or not the tribes were using the water. This decision was reaffirmed by the court in Arizona v. California when the court awarded water rights to five Indian reservations in the Lower Basin. The court determined the only feasible way the tribes' reserved water rights could be measured was on the amount of "practicably irrigated acreage" on the reservations. ●